and deep as to constitute its chief disadvantage, and there have probably been more fatalities due to this cause than to its explosiveness.

In order to compare the results of the oral administration of *sodium amytal* with the intravenous, thirty patients, ranging from ten to sixty-eight years, were given it by mouth in doses of five to fifteen grains one hour before operation. The minimum dose was used as no attempt was made to produce anesthesia, the drug being evaluated as a hypnotic only and nitrous oxid used for the anesthesia. The addition of a small amount of ether was necessary in three cases. This series is too small to permit any definite conclusion, but sufficient to show that oral administration is equally efficient and less objectionable, from a psychic standpoint, than the intravenous method. The possible safeguard of estimating dosage by noting blood pressure fall during intravenous administration is not entirely reliable, as frequently the drop comes several hours later. In all but three patients there was a fall in blood pressure of from ten to thirty degrees. One patient, with a preoperative systolic pressure of ninety, showed no depression during the operation, but five hours later had a drop of twenty-five degrees with respiratory depression and cyanosis which, however, responded promptly to ephedrin and caffein. Two patients were difficult to control for several hours postoperatively, and one exhibited mental confusion for two days. An acceleration of the pulse rate was noted in several cases which persisted for two or three days, but this was not constant and might easily have been due to other factors.

In all but two patients, one of whom had apparently acquired a tolerance from previous use of amytal, sleep supervened in five to ten minutes. Four patients received one-eighth to one-fourth morphin in addition. It was noticed that there was some postoperative nausea in these cases and that where morphin was omitted nausea occurred in but one patient.

The conclusions reached from this series was that the barbiturates have a definite field as hypnotics; that they compare favorably with the combinations of opium derivatives and scopolamin; but that, as the lethal dose in man has not yet been determined, their use as anesthetics is not safe.

There has not been as yet a sufficient number of cases reported from which to judge the comparative merits of the barbiturate group and tribromethanol, but a few definite conclusions may be made.

Their hypnotic effect is about the same. There are no morbid after-effects in blood or urine excretion. Nausea is rare with either drug. Their depressant action on respiration is about the same, but is not sufficient to be an objection. They both depress blood pressure, sodium amytal somewhat more than avertin.

All of the arguments in favor of their psychic value as a preliminary to inhalation anesthesia have double force when the anesthesia used is spinal. In this form of anesthesia there is a greater need to allay the fears of the patient than in any other. Finally, the barbiturates have been proven to decrease the toxicity of the cocain derivatives.

807 Francisco Street.

KEINBOCK'S DISEASE*

COMPRESSION OSTEITIS OF SEMILUNAR OR LUNATE BONE OF THE WRIST

REPORT OF CASES

By N. AUSTIN CARY, M. D.
AND
LEONARD BARNARD, M. D.
Oakland

DISCUSSION *by H. D. Barnard, M.D., Los Angeles; Lionel D. Prince, M.D., San Francisco; Maynard C. Harding, M.D., San Diego.*

A RADIOGRAPHIC interpretation of an osteitis of the lunate or semilunar bone of the wrist joint was made by Keinbock [1] in 1910. Kellogg Speed [2] in his book published in 1916 refers to the same lesion of the wrist joint and calls it Keinbock's disease. Speed was of the opinion that the condition was a fracture of the semilunar with fragmentation rather than a true osteitis.

Mark Rogers [3] of Boston gave a very excellent description of this same condition in 1922, reviewed seven cases reported by Preiser in 1910, and five cases reported by Guie in 1916. His observation was based upon five cases and called special attention to the resemblance the lesion had to Kohler's disease of the tarsal scaphoid and to Kummel's disease of the vertebral bodies. He believed the lesion to be an osteitis, the result of a trauma.

Erich Soupe [4] in 1923 reviewed fifty cases of the same lesion, twenty reported by Becker; sixteen by Keinbock; seven by Guie; six by Finister, and added one additional case. Ralph Goldsmith [5] in 1925 added one case and reviewed Soupe's group. R. Fontaine [6] in 1925 reported one additional case and reviewed a case reported by Mueller not previously mentioned by other writers. Mueller's case was later referred to by Henderson [7] in an article on Keinbock's disease in which he added two case reports. Roscoe Webb [8] reported one case in 1926 and H. D. Sonnenschein [9] reported a case in 1927.

In all it would appear that about seventy cases have been reported, making it seem that the lesion was comparatively rare. It is our contention that the occurrence is much greater, but that unrecognized cases are far greater than the reported.

ETIOLOGY

The ratio of incidence, according to Soupe, is seven to one in favor of men. The right wrist

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is involved two and one-half times as frequently as the left. The lesion has never been observed in children or in advanced age, but is confined to the third and fourth decades. The laboring class furnish the majority of the afflicted.

A fall upon the dorsiflexed wrist is given as the most common etiological factor. Repeated minor trauma may also incite the disease. Our observations show a single trauma that suddenly forces the wrist joint into dorsiflexion.

The majority of writers agree there are three distinct forms with relation to etiology:

(a) *Anatomical,* due to abnormal pressure lines from anatomical anomalies. No case reports were given in any of the reviews which demonstrated this form.

(b) *Occupational,* due to repeated minor traumata.

(c) *Traumatic,* due to a single violent injury. The greater number of cases fall into this class, the mechanism usually being an avulsive movement which forces the wrist joint into dorsiflexion, producing a momentary volar dislocation of the lunate bone, accompanied by an avulsion of the dorsal ligamentous attachments holding the principal blood supply and followed by a spontaneous reduction at once or within a short time following the accident. The nutrition of the bone is interfered with either by direct severance or an ischemic result from torsion, traction, and pressure.

SYMPTOMS

The symptoms and mode of onset, it can be seen, will vary greatly with the type of etiology responsible. In the first two groups the development is insidious, while in the traumatic form the symptoms at the time of injury may be mild or severe. Pain in the wrist joint is the principal symptom and may last from a few hours to several days. Moderate swelling about the joint generally follows the accident and may very rapidly subside. Loss of function is dependent upon the amount of pain and swelling present. In practically all cases the acute symptoms subside in from one to fourteen days, leaving only a lame soreness on forced movements.

The late symptoms appear in from one to nine months after the original injury in the traumatic group. No definite time of late symptoms can be given in the first two groups. Lameness, pain and soreness on jarring or forced movements are the principal complaints, with swelling over the dorsal surface of the wrist joint distal to the annular ligament—the amount depending greatly on the amount of usage. Minor repeated traumata greatly aggravate the traumatic form at this stage. Rest will relieve all symptoms temporarily, but they recur upon the resumption of activity. Localized tenderness, directly over the carpus involved, is the most persistent physical finding. All movements are decreased over the normal, especially dorsiflexion and forced movements beyond certain limits produce pain in the wrist joint.

X-RAY FINDINGS

The x-ray findings are very characteristic and are the principal factor in making a diagnosis. The lunate or semilunar bone shows a marked compression, seen best in a lateral view of the wrist joint. The size of the bone is reduced from one to two-thirds its normal; the anteroposterior measurement is decreased and the body flattened.

Late in the disease there is absorption or decalcification, giving the appearance of multiple fragments which may lead to the diagnosis of fracture with nonunion of fragments. The normal space occupied by the lunate bone becomes reduced in size. As the collapse due to softening occurs, the neighboring bones move in to close the area. The picture at this stage is very suggestive of a Kohler's disease of the tarsal scaphoid.

TREATMENT

Reviewing the various comments in the reported cases on the methods of treatment, one arrives at the conclusion that surgical removal has given the best results. Mueller in his case curetted out the softened cancellous portion of the lunate bone, leaving the cortex as a shell. He reports a good functional result. Henderson advises a conservative plan of rest by splinting and expectancy, believing a functional wrist will eventually result.

In the early cases giving a typical history and physical finding with negative x-ray, Goldsmith advises immobilization from four to eight weeks, with dorsovolar pressure, traction being applied to the great finger to minimize the physiological pressure upon the carpus.

In the later cases, showing compression with persistent symptoms, surgical removal is the method of choice. Sonnenschein used rest and physical therapy measures for six weeks without relief of symptoms in his patient. Ostectomy was then done of the entire bone. His patient was able to return to work six weeks after operation. He does not state, however, the type of work. Our experience would not permit heavy normal labor in so short a time.

OPERATION

The operation of choice is a volar approach to the carpal bone. A longitudinal incision about two inches long is made directly over the lunate bone, which divides the skin and subcutaneous tissues. By careful blunt dissection, the tendons are separated without opening the sheaths and retracted laterally; the median nerve is to be avoided and retracted laterally. The anterior or volar ligament is then divided as far upward as required for good exposure and by blunt dissection all tissues are freed from the volar surface of the bone. The lunate bone is recognized, care being taken to identify the carpus to be removed. The bone shell is thin, an oily fat fluid can be expressed from the bone, the appearance is decidedly darker than the normal carpus—the size smaller and quite friable. The bone is then rolled out sufficiently to permit its dorsal attachments to be divided. Closure is made in two layers, first uniting the cut volar ligaments. The

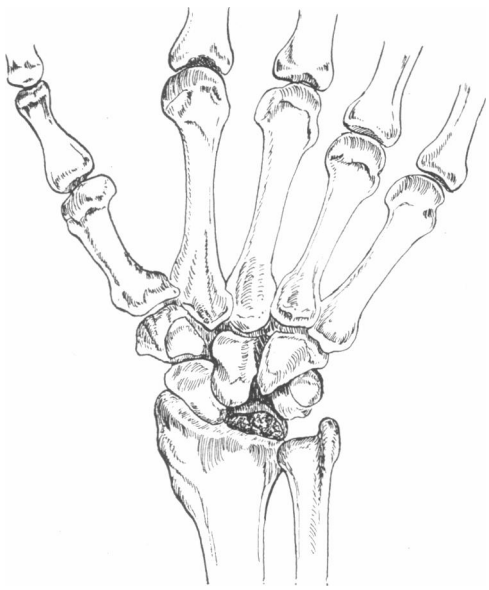

Fig. 1

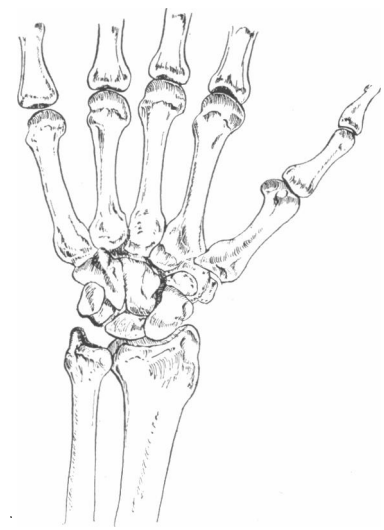

Fig. 2

Anteroposterior view. Drawing from x-ray of Case 1. Shows atrophic changes in lunate and compression of the entire bone when compared with the normal.

tendons and median nerves are allowed to drop into place and the skin and subcutaneous tissue closed. No splinting is used. Dressings are secured in place with a crêpe-paper bandage. Early movement is instituted.

Four to eight weeks are required for subsidence of symptoms, although some cases were reported as working in six weeks after surgery. There were no failures reported from the surgical cases, while no reports were made on the eventual results on the nonsurgical.

REPORT OF CASES

Case 1.—Mr. R., age twenty-eight years, observed May 1, 1926, truck driver. Gave a history of having the right wrist joint forcibly dorsiflexed while unloading a heavy piece of machinery. Severe pain was experienced immediately in the wrist joint. Swelling soon followed; he was unable to continue with his work and was referred to the company industrial surgeon for treatment. Roentgen rays of the joint were negative for fracture or dislocation. A diagnosis of sprained wrist was made and supportive treatment instituted. After three months of rest and physical therapy measures, consisting of radiant heat and massage, also active and passive movement, his symptoms were greatly improved, but never to the point that he could resume his duties because forced movements always caused pain. Point tenderness was present over the carpal bones. Roentgen rays were again made and a diagnosis of arthritis of the wrist joint made; decalcification of all bones of the wrist joint was shown. Tuberculosis of the lunate bone was advanced and immobilization was again instituted.

Patient was first observed by us six months after injury. His general physical examination was excellent. The Wassermann, Von Pirquet and Koch old tuberculin tests were negative. An x-ray examination of his chest was negative for old or new tubercular lesions. The right wrist joint was normal in appearance; movements reduced about one-half the normal left. The grip was very poor. Flexion of the fingers was limited, the tips of the fingers falling one-half inch from the mid-palm; this we attributed to a myofascitis due to his long immobilization. There was point tenderness present to both volar and dorsal compression over the carpus. Roentgen-ray graphs of both wrists showed the right lunate bone markedly compressed. (See Figs. 1 and 2.)

A diagnosis of osteitis of the semilunar bone was made under the special classification of Keinbock's disease, and surgical removal advised.

The differential diagnosis in this case between infectious arthritis, tuberculosis of the lunate bone, and Keinbock's disease, based upon general experience, was not difficult. In tuberculosis of bone the primary lesion would require a longer time for development, at least nine months being required for foci of tuberculosis to progress so far in a bone. In arthritis the changes would be more general, involving more than one bone.

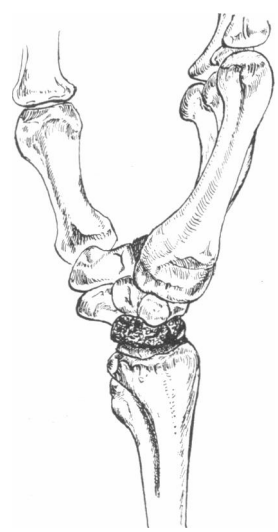

Fig. 3

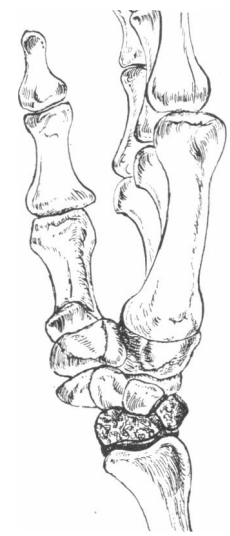

Fig. 4

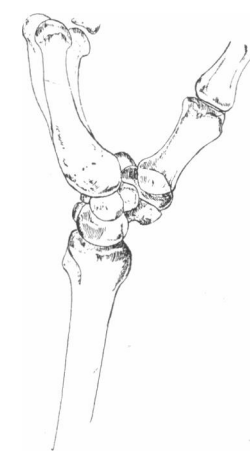

Fig. 5

Lateral views in Cases 1 and 2. Show atrophic compression elongation of the lunate when compared with the normal of the same patient.

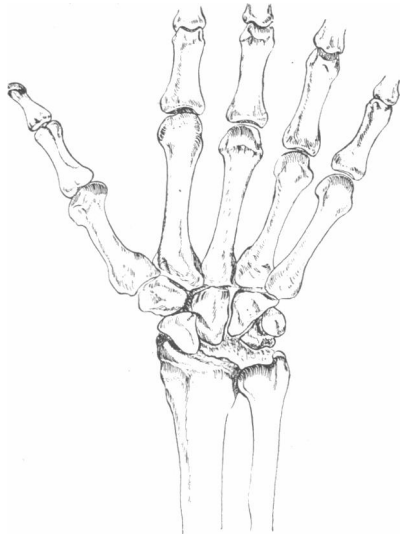

Fig. 6

Drawing of x-ray made after removal of lunate. Note that the space so left has been gradually obliterated.

This was our first case under this diagnosis, and operation was planned as in removal of a fractured semilunar. The approach was through the dorsal incision directly over the bone, the tendons were carefully retracted and the dorsal ligaments incised to the bone. After considerable dissection with a sharp periosteal elevator, we were unable to locate any bone which appeared damaged. The field was extended, exposing the entire scaphoid and most of the os magnum and cunieform, but the lunate could not be located. Placing retractors between the scaphoid and cunieform, an opening was made at the bottom of which lay the lunate bone; retraction was increased, the bone grasped with forceps, which collapsed under the slightest pressure, requiring the removal in sections. The cavity was flushed with warm normal salt solution and wiped dry with cotton pledgets. The wound was closed in two layers, one deep and the other of skin and superficial fascia. Healing was uneventful. Six months was required before this patient could be induced to work. Pain had been completely relieved, but function was not complete and he questioned his compensation status if he went to work too soon. On last observation, one year after surgery, he was free from pain and working. Palmar flexion was slightly less than the normal left.

* * *

CASE 2.—Mr. B., age forty-three years, carpenter, came under observation in April 1928. He gave a history of having the right wrist forcibly dorsiflexed eight months previous while handling a heavy timber. Sudden intense pain in the wrist joint was felt. The pain gradually subsided in about an hour. There was limitation in movement, in fact he experienced a certain amount of relief by manipulation. A throbbing was present when he stopped movement. He continued with his work for two weeks.

Because of a continued soreness on movement, he consulted his industrial surgeon, who advised immobilization. A bandage was applied; this method of treatment was continued for six weeks with but moderate relief. He was advised that absolute rest would be required. This he refused, as his work was now light and his symptoms no worse. No x-rays were made on the case. Four weeks before we observed him and seven months after injury, swelling developed over the dorsum of the wrist joint, at the distal end of the radius and distal to the annular ligament. Pain had grown worse under heavy lifting.

On observation there was a moderate swelling present, as above described. His movements in the right wrist joint were reduced one-half the normal left. Point tenderness was present over the lunate bone, both dorsal and volar. He complained of pain on all forced movements of the wrist joint and upon grasping firmly or lifting. His general physical examination was negative, also his laboratory tests.

An x-ray examination was made in anteroposterior and lateral positions. The lunate bone was reduced in size, below the normal. The opposite wrist was x-rayed for comparison (see Figs. 2, 3, and 4). In the lateral view (see Figs. 3 and 4) the bone was seen to be markedly compressed; the anteroposterior mensurations increased and areas of decalcification were present, giving the appearance of multiple fragments, especially upon the volar side.

Surgical removal was advised, but patient requested that nonsurgical methods be tried first. A leather cuff support was provided with a thumb strap to hold the appliance in position. Diathermy to the wrist joint by the direct method was given daily for two weeks, followed by every other day for a like period. Complete relief of pain and subsidence of swelling was obtained by this treatment.

Reviewing the dates in this case, I find his injury occurred October 6, 1927. Symptoms were present to April 19, 1928, when we first observed him, and worse four weeks preceding our observation. Fixation and physical therapy measures were instituted on May 1, 1928, with marked relief of all symptoms in thirty days. This method of treatment was continued for two and one-half months, when a maximum of improvement was apparently reached—movement was limited; pain was produced on forced flexion extension; swelling had subsided; he was unable to work. Operation was agreed upon and done on July 25, 1928. Physical therapy measures were again instituted on August 20, 1928, and continued three months. He returned to light duty on August 20, 1928 (no heavy work), four weeks postoperative and to full duty on November 1, 1928.

Our report of November 24, 1928, is as follows:

"Since operation patient has complained of a disturbance in sensation in the thumb, index and ring fingers of the operated hand, explaining that he was unable to tell when he had a small object, like a coin or his watch ring, between his fingers and thumb. There was no evidence of deformity or disability incident to movement and function in the fingers. Movements of the wrist joint were reduced one-half the normal left."

On observation, January 31, 1929, sensation had returned to the extent that he could distinguish small objects with the index finger and to a much less degree with the thumb. His ability to flex and extend the wrist showed a material improvement over our last report, being approximately four-fifths the normal.

Our last observation of this patient, April 1, 1929, showed complete return of sensation, with no additional improvement in movement. Fig. 6 shows the present appearance of the bones of the wrist joint.

2939 Summit Street.

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DISCUSSION

H. D. BARNARD, M. D. (2417 South Hope Street, Los Angeles).—I quite agree with the author that this condition is frequently overlooked. The figures of the reported cases do not allow of a proper estimation of the frequency of occurrence although the condition is comparatively rare. I am inclined to favor the fracture element from an etiological standpoint; the trauma in the very few cases I have seen being relatively severe, one case having resulted from a golf-club swing. The volar approach is preferable in surgical removal procedures. Pain is liable to persist over a long period after surgical removal and a decided weakness is quite likely to be permanent. One patient operated upon early in 1928 estimates the strength of the wrist at 50 per cent of previous strength and his judgment is not influenced by any element of compensation.

❀

LIONEL D. PRINCE, M. D. (490 Post Street, San Francisco).—I agree with Doctor Cary that Keinbock's disease, which is a chronic, slowly progressive osteitis of the semilunar bone of the wrist, occurs much more frequently than the literature would indicate. It is always fallacious to judge the frequency of a condition of this type on the basis of literature alone, as the majority of cases that are observed are not reported. Personally, I have had two cases, both typical clinically and radiologically in every way. In both cases there was a history of trauma of rather severe nature.

In one case the injury occurred about fifteen years prior to the time when the patient came under my observation. He had received a severe injury to the wrist, the exact nature of which could not be determined. He was under medical observation for a long period of time. Over a year elapsed before the man regained the use of his hand and wrist. From a clinical point of view he eventually recovered and when he was seen by me he gave the history of recent symptoms arising from a sprain sustained a few weeks previously. X-ray graphs showed a partially dislocated semilunar bone, which was cystic and distorted. Excision of the bone resulted in a complete cure.

I believe that the disease is primarily circulatory in origin, the normal blood supply of the bone having been disturbed as the result of traumatization, with resultant disintegration and fragmentation of the bone. Excision of the bone is to be advised in all cases where painful symptoms persist, the procedure being very simple through the volar approach.

In the first case which came under my care, a certain amount of disability was permanent even after the diseased bone had been removed. This I attribute to the fact that the patient had sustained a fracture of the scaphoid and there was unquestionably other damage to the wrist joint besides that which was visible radiologically.

❀

MAYNARD C. HARDING, M. D. (700 Electric Building, San Diego).—I have never considered this a separate disease entity but only a typical response to loss of blood supply. All of the cases I have seen have had a severe trauma. The results of removal have not been very satisfactory. Those cases in which other inflammatory changes have been present, such as spurs, adhesions, and pannus, have not been helped much by operation.

It is important in industrial surgery to give a guarded prognosis, as many of these cases will never be able to do hard labor again.

❀

DOCTORS CARY AND BARNARD (Closing).—Our last observation on Case 2, made on April 1, 1930, showed flexion extension to be approximately four-fifths the normal, grip normal, with a complaint of pain on forced rotation, such as is encountered in using a screw driver. Patient made no other complaints.

We believe that complete removal of the affected bone is necessary for relief of symptoms, and that eventual recovery can be expected, though a long period of partial disability must be anticipated.

THE DETERMINATION OF ERYTHROCYTE MEASUREMENTS—CLINICAL SIGNIFICANCE OF A NEW, SIMPLE METHOD*

REPORT OF CASE

By GARNETT CHENEY, M. D.
San Francisco

DISCUSSION *by W. T. Cummins, M. D., San Francisco; E. M. Hall, M. D., Los Angeles; H. A. Wyckoff, M. D., San Francisco.*

EXTENSIVE studies of erythrocyte morphology have established the importance of measuring the diameter of red blood corpuscles. Their size is fairly constant in normal individuals, but they may show characteristic changes in several diseases which produce an abnormal blood picture. In a few diseases such changes are sufficiently constant and striking to be of diagnostic significance. However, the methods usually employed have been so laborious that they have not come into widespread use. Consequently an intimate knowledge of the subject has been more or less confined to those medical centers which carry on extensive investigations of the blood dyscrasias.

Eve's halometer [1] for measuring the average mean diameter of erythrocytes is so simple an instrument that, if it is proved accurate for general clinical use, measurements of the red blood cells may be included in routine examinations of the blood, and the information so obtainable will be familiar to all who practice medicine. Three hundred blood films from some two hundred different cases have been measured by Eve's method, and the results compared with those of other investigators using the already well-established methods. The findings have been grouped according to the relative importance of the disorders in which they occur.

Historical.—Two methods of measuring the size of erythrocytes have been in use some years. The original method was the use of the micrometer to measure the diameters of the cells by direct observation. Each cell, one after the other, is brought into focus under the microscope and measured. Usually two hundred cells are examined. Price-Jones [2] has developed a different procedure. The images of the cells are projected and drawn. The tracings of two hundred to five hundred cells are carefully measured and the diameters of the cells calculated. Such a blood examination occupies about four hours' time.

In 1924 Pijper [3] described the eriometer. A blood film is used as a diffraction grating, and the colored haloes so formed bear a constant relationship to the size of the red cells. Only the mean diameter can be obtained by this method, but this may be from over one million cells. It is interest-

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